

U. S. DEPARTMENT OF COMMERCE
DANIEL C. ROPER, Secretary
NATIONAL BUREAU OF STANDARDS
LYMAN J. BRIGGS, Director

DOMESTIC BURNERS
FOR
PENNSYLVANIA ANTHRACITE
(UNDERFEED TYPE)

OCT 3 1934

LIBRARY COMMERCIAL STANDARD CS48-34

[Issued August 18, 1934]

Effective Date for New Production August 1, 1934



A RECORDED STANDARD OF THE INDUSTRY

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1934

PROMULGATION STATEMENT

On March 14, 1934, at the instance of the Anthracite Institute Laboratory and with the endorsement of the principal manufacturers of domestic underfeed burners for Pennsylvania anthracite, a general conference of representative manufacturers, installing contractors, and users adopted Commercial Standard CS48-34 for this commodity. The industry has since accepted and approved for promulgation by the Department of Commerce, through the National Bureau of Standards, the standard as shown herein.

This standard is effective for new production beginning August 1, 1934.

Promulgation recommended.

I. J. Fairchild,
Chief, Division of Trade Standards.

Promulgated.

Lyman J. Briggs,
Director, National Bureau of Standards.

Promulgation approved.

Daniel C. Roper,
Secretary of Commerce.

DOMESTIC BURNERS FOR PENNSYLVANIA ANTHRACITE (UNDERFEED TYPE)

COMMERCIAL STANDARD CS48-34

PURPOSE

The purpose of this standard is to serve as a basis for certification of quality and performance of burners covered herein by the manufacturer, the installing contractor, or by a neutral inspection agency; or as a basis for performance criteria on the part of the buyer.

SCOPE

This standard covers underfeed type burners, installed for heating buildings, using Pennsylvania anthracite as a fuel, and having a normal capacity not to exceed 50 pounds of fuel per hour.

CONSTRUCTION REQUIREMENTS

1. *General*.—Burners shall be of rugged construction and as simple in design as the type will permit. They shall be made of materials recognized by the engineering profession as being particularly suitable for high temperature work at points where high temperatures occur, or else they shall be so effectually cooled as to make the use of such special materials unnecessary.

2 (a). *Coal hopper*.—In cases where the coal is not fed direct from the storage bin, a hopper shall be provided having a capacity at least equal to 15 times the maximum hourly rate of coal feed. For purposes of computation no coal lying at a flatter angle than 35° from the bottom outlet shall be included.

(b) In the event, however, that the above specification would normally require a hopper capacity in excess of 400 pounds, a 400-pound capacity may be considered an allowable maximum at the discretion of the manufacturer.

(c) The lower charging edge of regular coal hoppers of 400 pounds capacity and under shall be not higher than 48 inches above the firing floor level.

(d) The burner shall include a positive means for preventing dust or gas from entering the cellar through the hopper or other external parts.

3. *Weight of metal*.—Weight of metal of hopper shall be not lighter than shown in table 1.

TABLE 1.—*Weight of hopper material*

Capacity of hopper (pounds)	Minimum thick- ness of metal	
	U. S. stand- ard gage	Inch
0 to 100	22	0.031
101 to 200	20	.037
201 to 400	18	.050

4. *Assembly*.—All metal parts shall be rigidly fastened. The use of “metal screws” in the fan, hopper or elsewhere will not be tolerated.

5. *Accessibility*.—Ash and coal conveyors shall provide means for the ready removal of foreign material.

6. *Protection*.—All moving parts shall be adequately protected or enclosed to prevent accidental personal injury. All moving parts shall be protected from undue strain by suitable electrical or mechanical means. Overload protective devices shall be so arranged that the user may reset mechanism.

7. *Ash removal system*.—(a) The ash receptacles, whether they take the form of cans outside the furnace or a space beneath the furnace, shall have at least sufficient capacity to receive the ashes from 15 hours’ operation at maximum rated capacity.

(b) The ash receptacles, whether of the space or can type, shall be effectively covered to prevent the emission of dust or infiltration of cold air.

(c) All parts of the ash-removing mechanism shall be constructed of materials which can be shown by experience and test to be capable of reasonably withstanding the abrasions of ash and clinker.

(d) All bearings of the ash removal system shall have provision for effective lubrication or shall be made of corrosion resistant materials, suitable for indefinite service under the intended conditions of operation.

(e) Ash removal parts subject to wear or corrosion shall be designed in such a manner that they may be readily renewed.

8. *Coal-conveying systems*.—Coal conveying worms, plungers, or other devices shall be constructed of corrosion-resisting material or shall be of such heavy construction as to provide for reasonable life.

9. *Motor*.—The motor shall comply with A.I.E.E. standards. It shall be free from interference to radio reception. It shall have sufficient capacity to operate the entire unit continuously at the maximum rating of the burner without overheating.

10. *Lubrication*.—The entire mechanism shall be provided with means for adequate lubrication, with the permissible exception as provided in paragraph 7 (d). Lubrication places shall be convenient, conspicuous, and obvious. The burner shall be so designed that adequate lubrication is secured without frequent attention.

11. *Fan*.—The entire feed-draft system shall be designed so as to maintain as nearly a constant-volume flow of air at a fixed setting of air control as may be practical. In the event a fan is used, the fan runner shall be so constructed, balanced, and operated as to

insure quiet operation. The casing and intake shall be designed in such a manner as to eliminate excessive "spill." The use of poorly balanced paddles or paddles which can be readily bent out of place shall not be tolerated.

12. *Siftings*.—The burner air passages shall either include mechanical means for removing siftings from air passages or shall demonstrate by actual test that siftings will not interfere with operation.

13. *Appearance*.—The appearance and painting shall be satisfactory.

14. *Proof of durability and construction*.—Where certain metals or types of construction are specified herein for the purpose of insuring durability and long life, a demonstration that the material or construction method has resulted in satisfactory operation in the field for a continuous unrepaired period of 2 full heating seasons, and on at least 12 units, shall be accepted as conclusive evidence of acceptable design.

15. (a) *Limit controls*.—The control systems of all burners shall include reliable means for effectually checking the fire so as to keep the operating conditions of the heating system within safe limits at all times.

(b) In steam systems this control shall function so that the boiler pressure can never exceed that allowed by the A.S.M.E. boiler code for the type of boiler in question, and preferably shall be limited to at least 5-lb / in² below the setting of the safety valve.

(c) In ordinary vapor systems this control shall meet the conditions for steam boilers, and in addition shall preferably be calibrated in ounces instead of pounds, and be sufficiently sensitive to function on less than 1 lb/in² pressure. In those vapor systems wherein excess pressure disturbs the normal venting or sealing of the system, this control shall never permit the pressure to exceed the maximum specified by the manufacture of the heating system.

(d) In hot-water systems this control shall function so as to prevent the formation of steam.

(e) In warm air systems this control shall function so as to limit the temperature of the air entering the circulation system to a maximum of 250° F.

INSTALLATION REQUIREMENTS

16. *Capacity*.—A measurement of the radiation in the building will be required to which an allowance of 20 percent shall be added to care for mains and risers. The total thus secured must be less than the approved rating granted to the burner as described in paragraph 31. This rating shall be within the capacity of the boiler. The capacity of the boiler shall be construed to mean the actual output which the boiler manufacturer will certify as having been obtained under a standard test such as that prescribed under code no. 3 of the American Society of Heating and Ventilating Engineers.

17. *Ash clearance*.—In the case of burners which do not have a positive means of forcing ash into the ashpit, the following minimum open spaces shall be left on all sides of the tuyere:

Maximum rate of coal feed of 30 pounds per hour or under, 2½ inches minimum clearance.

Maximum rate of coal feed of 30 to 50 pounds per hour, 3½ inches minimum clearance.

18. *Indirect water heating loads.*—In the event that an indirect service water coil is attached to the boiler, a load equivalent to the number of Btu which will be used in heating the rated number of gallons of service water through a 100 degree temperature rise shall be added to the measured radiation and considered a part of the radiation load. The rated capacity of the burner must thus exceed the sum of the measured radiation plus 20 percent mains and risers allowance plus service water load as obtained by the above methods.

19. *Relation of steam and water radiation.*—Steam radiation is considered to require 240 Btu's per hour per sq ft of direct radiation surface. Hot water radiation is considered to require 150 Btu's.

20. *Quietness of operation.*—The burner shall be so installed as to insure quiet operation.

21. *Electrical connections.*—All electrical wiring and equipment shall be installed in accordance with the National Electrical Code and any modifications or amendments to that code required by local regulations or ordinances.

22. *Workmanship.*—All work shall be finished and painted. All doors shall be made to fit tightly and all other openings shall be permanently sealed so that there will be no gas or dust leakage.

23. *Flue damper.*—The flue damper shall be so constructed that when closed adequate opening is provided to prevent accumulation of gas.

24. *Chimneys and flues.*—Chimneys and flues at the time of installation shall be of suitable design, height, and size to insure a negative pressure in the furnace under all conditions of weather and firing.

25. *Smoke breeching.*—It shall be the duty of the installing contractor to check smoke breeching and stove pipe to see that they are in a safe and satisfactory operating condition at the time of installation.

OPERATING REQUIREMENTS

26.—*Efficiency.*—The over-all efficiency of the unit at all points above 50 percent of maximum coal feed shall be above 50 percent when installed in a round sectional cast iron boiler having three intermediate sections and 1½ inches of asbestos insulation or its equivalent in good condition of repair, operating at 50 percent or more of the boiler capacity. The efficiency, as herein defined, shall be maintained for any continuous period of 4 hours during any test or observation run.

27. *Ash loss.*—Combustible in ash shall not exceed 7.5 percent of the Btu content of the coal as fired at any rate of coal feed above 50 percent of maximum. Methods of test according to test code no. 3 of the American Society of Heating and Ventilating Engineers are to be followed in all details applicable to stoker testing.

28. *Clinker.*—Ash removing systems must at all times be capable of disposing of any clinker which may be formed under any conditions of operation with the coals prescribed in paragraph 31(c).

29. *Combustion rate.*—A combustion rate of at least 13 lb/ft² of horizontal projected area of ash ring per hour must be continuously maintained for at least 9 hours with the above conditions of efficiency, ash, and clinker.

30. *Flue gas.*—Flue gas shall be not below 6 percent in carbon dioxide content with a reasonably tight boiler at any rate of operation above 50 percent of maximum coal feed.

31. (a) *Maximum rating.*—The maximum rating, in terms of gross square feet of water or steam radiation which the burner will supply, when intended for installation in the average existing cast-iron boiler shall be 90 percent of the maximum steam produced in a round cast-iron boiler in good repair having three intermediate sections and the equivalent of $1\frac{1}{2}$ inches of asbestos insulation. However, in no case shall the maximum rating be greater than 29 sq ft of direct steam radiation for each pound of coal fired, per hour, and in no case shall ratings be based upon efficiency figures below 50 percent.

(b) The maximum rating as defined in the preceding paragraph shall be based upon combustion of Pennsylvania anthracite having the following approximate analysis:

(c) Volatile matter 3.5 to 9 percent; ash content not to exceed 15 percent; sulphur content under 1.5 percent; ash fusing temperature $2,750^{\circ}$ F. or above (volatile, ash and sulphur content on dry basis in accordance with A.S.T.M. method D271-33); Btu content 12,000 or above; properly sized as follows: A no. 1 buckwheat should pass through a round mesh screen having $9/16$ -inch holes and over a similar screen having $5/16$ -inch holes. The undersizing should not exceed 15 percent and the oversizing should not exceed 10 percent. A no. 2 buckwheat (rice) should pass through a round mesh screen having holes $5/16$ inch in diameter and over a like screen having holes of $3/16$ inch in diameter. The undersizing should not exceed 15 percent and the oversizing should not exceed 10 percent.

32. *Coal storage.*—It is recommended that the coal bin or closet be constructed so as to be dustproof.

33. *Electrical consumption.*—The electrical consumption shall not exceed 18 kwh per 2,000 lb of coal burned at any rate of coal feed above 50 percent of the maximum.

34. *Operation upon other sizes of coal.*—The foregoing specifications have been drafted for operating upon the no. 1 and no. 2 buckwheat sizes of anthracite. In the event that other sizes are recommended, ratings shall be based upon the same efficiency and ash loss requirements.

35. *Banking.*—The burner shall be so constructed or controlled as to maintain a fire during an indefinite banking period.

36. *Acceleration.*—When the burner resumes operation after a 12-hour banking period, the time required for the stack temperature to reach a normal maximum shall not exceed 60 minutes.

CERTIFICATION

It is recommended that manufacturers of burners conforming to this standard shall attach a printed label to the equipment in a conspicuous location which shall be worded as follows:

"This burner is certified jointly by the manufacturer and installing contractor to conform to all requirements of Commercial Standard CS48-34 for Domestic Burners for Pennsylvania Anthracite (Underfeed Type) issued by the Department of Commerce."

Manufactured by ----- Manufacturer
Installed by ----- Contractor

The label may also contain the following statement: "A burner of identical design, type and capacity has been tested and approved by the ----- Laboratory."

EFFECTIVE DATE

This standard is effective beginning August 1, 1934, for production of new burners.

STANDING COMMITTEE

The following are members of the standing committee appointed by the general conference of March 14, 1934, to represent the various phases of the industry and give final consideration to comments and suggestions for revision:

W. B. HUGHES, Iron Fireman Co., New York, N.Y.
G. M. PELTZ, Motorstokor Corporation, New York, N.Y.
O. F. OSTBY, Electric Furnace Man, Inc., New York, N.Y.
R. B. PLATKA, Distributor, Burlington, Vt.
C. D. GILPIN, Beckley Perforating Co., Garwood, N.J.
C. G. O'HARA, Norristown Foundry Co., Norristown, Pa.
S. B. SWANSON, Apex Tool Co., Bridgeport, Conn.
H. F. COX, Distributor, Electric Furnace Man, Paterson, N.J.
A. H. AMERDING, New Jersey Stoker Corporation, Newark, N.J.
H. T. COATES, National Association of Purchasing Agents, New York, N.Y.
ALLEN J. JOHNSON, Anthracite Institute Laboratory, Primos, Pa.
E. L. BULLER, Hudson Coal Co., Scranton, Pa.
C. M. DODSON, Weston, Dodson & Co., Bethlehem, Pa.
C. W. OBERT, American Society of Heating & Ventilating Engineers, New York, N.Y.
THOMAS URDAHL, Consumers' Advisory Board, National Recovery Administration, Washington, D.C.

HISTORY OF PROJECT

In response to a request from the Anthracite Institute Laboratory and the desire of a number of manufacturers of domestic underfeed burners for Pennsylvania anthracite that a commercial standard for their product be established, several preliminary conferences were held at which a proposed standard was drafted based upon a test code used by the Anthracite Institute Laboratory for approval of burners. After consideration of the proposed standard at a general conference at the Hotel McAlpin, New York City, on March 14, 1934, attended by representative users, installing contractors, and manufacturers, it was adopted by the conference, with a few final modifications, and recommended for acceptance by the industry to become effective for production of burners on August 1, 1934.

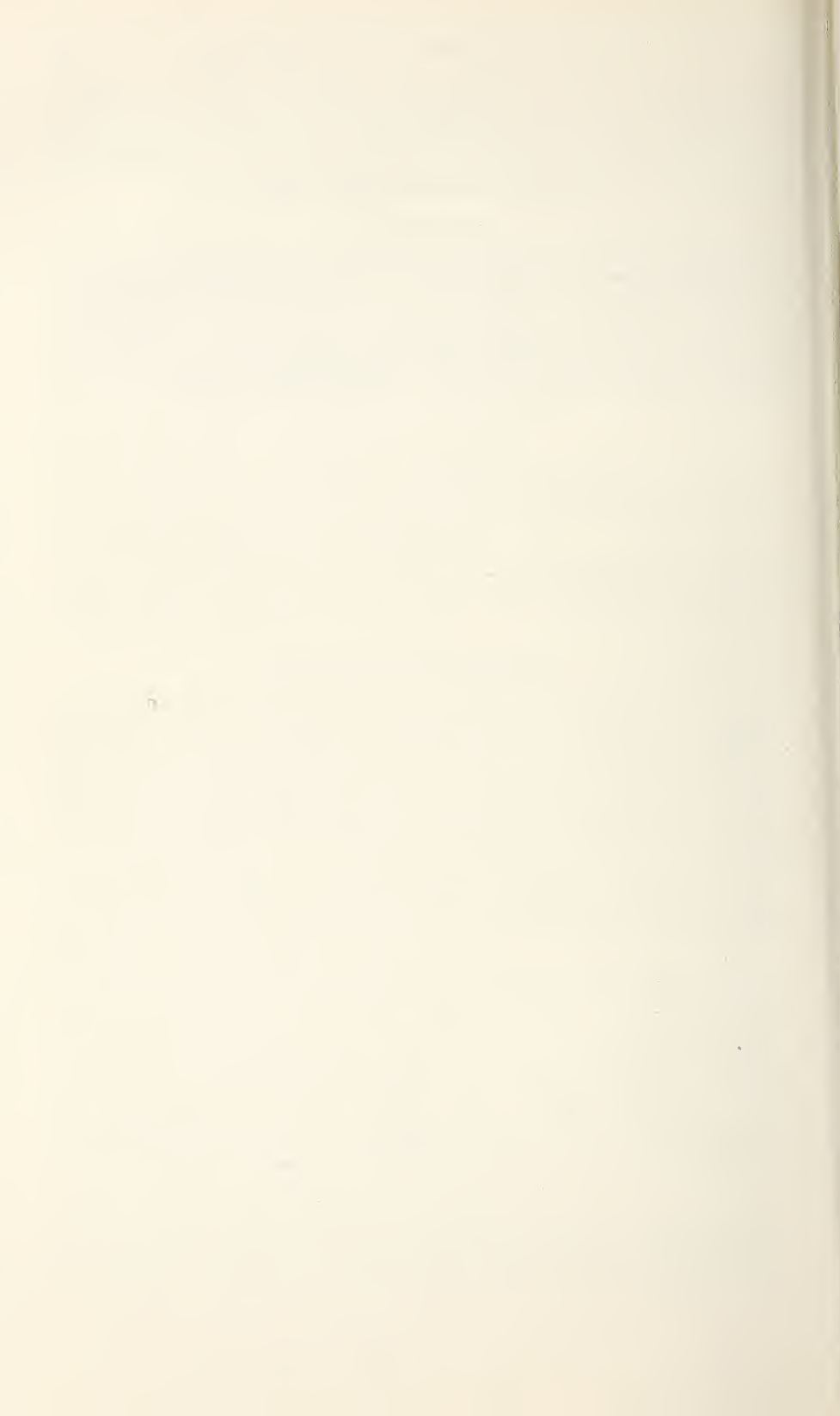
It was pointed out at the general conference that the standard covers requirements to be met by three separate interests, namely, the burner manufacturers, the installing contractors, and the mines with respect to coal for test purposes, and is an innovation in that respect. The requirements were made as broad as possible so as not to become a handicap to the introduction of future improvements. The standard is intended to protect the burner manufacturer, the installing contractor, and the purchaser from unfair competition by providing a basis of common understanding for the determination of burner quality and performance.

The conference also requested that the certification plan be applied to the standard, whereby those companies willing to certify that their burners conform to the standard requirements, will be listed as sources of supply for the information of prospective purchasers,

with special reference to those buying from tax moneys. Finally, a standing committee, as noted previously, was appointed to consider annually the need for revision of the standard and also to consider the desirability of submitting it to the American Standards Association for approval as an "American Standard", after a trial period.

APPENDIX

To promote a clearer understanding of the scope of this standard, it may be well to state that from the point of view of the National Bureau of Standards, the commercial standard offers no assurance that all fuel sold as Pennsylvania anthracite will prove satisfactory in all cases, nor that fuels from other districts may not be entirely suitable for use in standard burners. It may be well to note also that the operating efficiency set forth cannot be expected except under condition at least as favorable as those prescribed and unless the coal used complies with the requirements for Pennsylvania anthracite prescribed for test purposes.



ACCEPTANCE OF COMMERCIAL STANDARD

This sheet properly filled in, signed, and returned will provide for the recording of your organization as an acceptor of this commercial standard.

Date _____

DIVISION OF TRADE STANDARDS,
NATIONAL BUREAU OF STANDARDS,
Washington, D.C.

GENTLEMEN:

Having considered the statements on the reverse side of this sheet, we accept commercial standard CS48-34 as our standard of practice in the $\left\{ \begin{array}{l} \text{production}^1 \\ \text{distribution}^1 \\ \text{use}^1 \end{array} \right\}$ of domestic burners for Pennsylvania anthracite (underfeed type)

We will assist in securing its general recognition and use, and will cooperate with the standing committee to effect revisions of the standard when necessary.

Signature _____

(Kindly typewrite or print the following lines)

Title _____

Company _____

Street address _____

City and State _____

¹ Please designate which group you represent by drawing lines through the other two. In the case of related interests, trade papers, colleges, etc., desiring to record their general approval, the words "In principle" should be added after the signature.

TO THE ACCEPTOR

The following points are given in answer to the usual questions arising in connection with the acceptance form.

1. Commercial standards are commodity specifications voluntarily established by mutual consent of the industry. They present a common basis of understanding between the producer, distributor and consumer and should not be confused with any plan of governmental regulation or control. The U.S. Department of Commerce has no regulatory power in the enforcement of their provisions, but since they represent the will of the industry as a whole, their provisions through usage soon become established as trade customs.

2. *The acceptor's responsibility.*—The purpose of commercial standards is to establish for specific commodities, nationally recognized grades or consumer criteria and the benefits therefrom will be measurable in direct proportion to their general recognition and actual use. Instances will occur when it may be necessary to deviate from the standard and the signing of an acceptance does not preclude such departures; however, such signature indicates an intention to follow the commercial standard where practicable, in the production, distribution or consumption of the article in question.

3. *The Department's responsibility.*—The function performed by the U.S. Department of Commerce in the establishment of a commercial standard is fourfold; first, to act as an unbiased coordinator to bring all branches of the industry together for the mutual satisfactory adjustment of trade standards; second, to supply such assistance and advice as past experience with similar programs may suggest; third, to canvass and record the extent of acceptance and adherence to the standard; and fourth, to add all possible prestige to the enterprise by publication and promulgation when accepted by the industry.

When the standard has been endorsed by companies representing a satisfactory majority of production, the success of the project is announced. If, however, in the opinion of the standing committee of the industry or the Department of Commerce, the support of any standard is inadequate, the right is reserved to withhold promulgation and publication.

ACCEPTORS

(Individuals and organizations listed below have indicated in writing, acceptance of this specification as their standard of practice, but such endorsement does not signify that they may not find it necessary to deviate from the standard, or that they guarantee all their products to conform to the requirements of this standard.)

ASSOCIATIONS

American Boiler Manufacturers Association and Affiliated Industries, The, Cleveland, Ohio (in principle).
 Anthracite Institute Laboratory, Primos, Pa.
 Dairymen's League Co-Operative Association, Inc., New York, N.Y.
 Heating and Piping Contractors D.C. Association, Inc., Washington, D.C.

FIRMS

Anthracite Combustion Equipment Co., Hazleton, Pa.
 Anthracite Service Corporation, Trenton, N.J.
 Apex Tool Co., Inc., Bridgeport, Conn.
 Automatic Appliances, Inc., Philadelphia, Pa.
 Central City Engineering Co., Inc., Syracuse, N.Y.
 Chase and Waring, New York, N.Y. (in principle).
 Chew-Bittel Co., Philadelphia, Pa.
 Combustioneer, Inc., Springfield, Ohio.
 Cox, Harrison F., Paterson, N.J.
 Dickson & Eddy, New York, N.Y.
 Domestic Stoker Co. (Electric Furnace-Man), New York, N.Y.
 Dunkirk Radiator Corporation, Dunkirk, N.Y. (in principle).
 Federal Radiator Co., Irvington, N.Y. (in principle).
 Frederick Iron & Steel Co., The, Frederick, Md.
 Frost Research Laboratory, Inc., Norristown, Pa.
 Fuel Savers, Inc., Harrisburg, Pa.
 Heating and Ventilating, New York, N.Y. (in principle).
 Hudson Coal Co., The, Scranton, Pa.
 Industrial Specialty Co., Inc., Corning, N.Y.
 International Heater Co., Utica, N.Y. (in principle).
 Iron Fireman Manufacturing Co., Cleveland, Ohio, and Portland, Oreg.

Iron Fireman Sales Co., Portland, Maine.
 Keeler, M. E., Trucksville, Pa.
 Kewanee Boiler Corporation, Kewanee, Ill.
 Leonard, Frank E., Carlisle, Pa.
 Motorstokor Corporation, New York, N.Y.
 New Jersey Stoker Corporation, Newark, N.J.
 Commonwealth of Pennsylvania, Bureau of Standards, Department of Property and Supplies, Harrisburg, Pa. (in principle).
 Pressed Steel Co., The, Wilkes-Barre, Pa.
 Richardson & Boynton Co., New York, N.Y.
 Richmond Radiator Co., Inc., New York, N.Y. (in principle).
 Rodasy Products Co., Inc., The, East Hartford, Conn.
 Russell Coal Co., R. H., Poughkeepsie, N.Y.
 Sampsel-Mastoker Co., Lafayette, Ind.
 Seaconnet Coal Co., Providence, R.I.
 Stoker Sales Co., East Orange, N.J.
 Stokes, George S., Mahanoy City, Pa.
 Stove Mounters' International Union Journal, St. Louis, Mo. (in principle).
 Super-Stoker Co. of New Jersey, Upper Montclair, N.J.
 Trump Corporation, Syracuse, N.Y.
 United Stoke Corporation, Lafayette, Ind.
 Weston Dodson & Co., Inc., Bethlehem, Pa. (in principle).
 Wilson Co., E. A., Lowell, Mass.

GOVERNMENT

National Bureau of Standards, Division of Building and Housing, Washington, D.C. (in principle).
 U.S. Treasury Department, Washington, D.C.
 War Department, Washington, D.C.

COMMERCIAL STANDARDS

CS no.	Item	CS no.	Item
0-30.	The commercial standards service and its value to business.	24-30.	Standard screw threads.
1-32.	Clinical thermometers (second edition).	25-30.	Special screw threads.
2-30.	Mopsticks.	26-30.	Aromatic red cedar closet lining.
3-28.	Stoddard solvent.	27-30.	Plate glass mirrors.
4-29.	Staple porcelain (all-clay) plumbing fixtures.	28-32.	Cotton fabric tents, tarpaulins and covers.
5-29.	Steel pipe nipples.	29-31.	Staple seats for water-closet bowls.
6-31.	Wrought-iron pipe nipples (second edition).	30-31.	Colors for sanitary ware.
7-29.	Standard weight malleable iron or steel screwed unions.	31-33.	Wood shingles (second edition).
8-33.	Gage blanks (second edition).	32-31.	Cotton cloth for rubber and pyroxylin coating.
9-33.	Builders' template hardware (second edition).	33-32.	Knit underwear (exclusive of rayon).
10-29.	Brass pipe nipples.	34-41.	Bag, case and strap leather.
11-29.	Regain of mercerized cotton yarns.	35-31.	Plywood.
12-33.	Fuel oils (second edition).	36-33.	Fourdrinier wire cloth (second edition).
13-30.	Dress patterns.	37-31.	Steel bone plates and screws.
14-31.	Boys' blouses, button-on waists, shirts, and junior shirts.	38-32.	Hospital rubber sheeting.
15-29.	Men's pajamas.	39-32.	Wool and part wool blankets.
16-29.	Wall paper.	40-32.	Surgeons' rubber gloves.
17-32.	Diamond core drill fittings (second edition)	41-32.	Surgeons' latex gloves.
18-29.	Hickory golf shafts.	42-32.	Fiber insulating board.
19-32.	Foundry patterns of wood (second edition).	43-32.	Grading of sulphonated oils.
20-30.	Staple vitreous china plumbing fixtures.	44-32.	Apple wraps.
21-34.	Interchangeable ground-glass joints, stop-cocks and stoppers (second edition).	45-33.	Douglas fir plywood.
22-30.	Builders' hardware (nontemplate).	46-33.	Hosiery lengths.
23-30.	Feldspar.	47-34.	Marking of gold-filled and rolled-gold-plate articles other than watch cases.
		48-34.	Domestic burners for Pennsylvania anthracite (underfeed type).

NOTICE.—Those interested in commercial standards with a view toward accepting them as a basis of every day practice in their industry, may secure copies of the above standards, while the supply lasts, by addressing the Division of Trade Standards, National Bureau of Standards, Washington, D.C.



